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REVISION OF THE GENUS *Physorhinus* (COLEOPTERA, ELATERIDAE) IN NORTH, CENTRAL, AND SOUTH AMERICA[1,2]

PART I: Introduction and Key to the Species

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The genus *Physorhinus* as it is presently known occurs only in the New World, primarily in the Neotropics. This revision deals with the known species of North, Central, and South America, exclusive of the Galápagos Islands. The species treated here are alike in having a yellowish color on the frons, a character which was until recently considered distinctive for the genus, if not definitive. Seventeen such species from the southwestern United States, Central America, and South America were described between 1801 and 1903. Until now, no all-inclusive revision of their taxonomy has been undertaken.

HISTORICAL REVIEW

The genus *Physorhinus* was noted in 1833 in the third edition of the Dejean Catalogue and again in 1836 in Sibermann's Revue Entomologique, but in both cases, no validly described species were assigned to it. In 1840 Germar published descriptions first of *P. xanthocephalus* and later of *P. sturmii.* He mentions the morphology of the pleurosternal sutures, the second and third antennal segments and the metacoxal plates which in combination with the yellow frons became the hallmarks of the genus. Candèze revised *Physorhinus* in 1859, bringing together Fabricius' *Elater erythrocephalus*, described in 1801, Germar's two species, *P. galapagoensis* described by Waterhouse in 1845, and 6 new species

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first described at that time. *P. galapagoensis*, distinguished in his key by a prothorax which is only slightly narrowed and by a frons which has only the anterior border yellow, was placed in *Anchastus* in 1895 by Champion on the basis of its narrowly separated pleurosternal sutures. The remainder of the species Candèze separated on the basis of elytral maculation, pronotal punctation and the comparative widths of the prothorax and elytra; the latter character being of doubtful value for this purpose.

Several additional species were described in the ensuing years (Steinheil, 1875; Candèze, 1881, 1893). In 1895 Champion reviewed the Central American species and described 4 new ones. Two additional yellow-headed *Physorhinus* species were later described, one from Peru by Schwarz in 1902, the other from the United States by Wickham in 1903. More recently, Van Dyke in 1953 treated the *Physorhinus* species of the Galápagos Islands. He described 6 new species and included one formerly placed in *Anchastus*. This was the first work to include within the genus beetles which do not have the classical yellow frons.

Physorhinus Germar, 1840

Dejean, 1833. Catalogue des Coléoptères . . . de M. le comte Dejean, ed. 3, p. 86 (2 manuscript species).

Eschscholtz, 1836. [Table of] Classification des elatérides . . . Rev. Ent., 4:4. (In table without species.)

Germar, 1840. Zeitschr. Ent., 2: 245. (Type species of the genus: *P. xanthocephalus*, Monobasic.)

Lacordaire, 1857. Gen. Col., 4: 167, 175.

Candèze, 1859. Mon. Elater., 2: 387.

Candèze, 1891. Cat. Elat., p. 103.

Champion, 1895. Biol. Centrali-Americana, Insecta, Coleopt., 3: 385.

Schwarz, 1906. *In* Wytsman, Gen. Ins., fasc., 46, Elater., p. 131.

VanDyke, 1953. Occ. Papers California Acad. Sci., no. 22, p. 46.

It is not clear which characters separate *Physorhinus* from the closely related genus *Anchastus* (LeConte, 1893). In the past these two genera were separated by the yellowish color of the frons (present in *Physorhinus*, absent in *Anchastus*), the relative lengths of antennal segments 2 and 3 (equal or subequal in *Physorhinus*, 3 longer than 2 in *Anchastus*), the extent of the caudal expansion of the metacoxal plates (reaching to or just short of the second abdominal segment in *Physorhinus*, considerably shorter in *Anchastus*) and the extent and nature of the separation between the pleurosternal sutures (most widely separated toward the center of their length in *Physorhinus*, evenly and rather narrowly separated throughout in *Anchastus*). On the basis of studies conducted

in the preparation of this work, I believe that none of these characters is completely reliable.

I have examined *A. digitatus* LeConte, the type species of *Anchastus*, and find that it differs in several respects from *P. xanthocephalus* Germar, the type of *Physorhinus*. In *A. digitatus* the pronotum is longer than wide, the anterior edge of the prosternal lobe is sculptured to give a scalloped effect, the pleurosternal sutures are narrowly and evenly separated throughout their length, the male genitalia are short and broad, with the apices of the parameres blunt or subquadrate in form, the female bursa bears two bulbous colleterial glands, and the spermatheca is greatly elongated and contorted. *P. xanthocephalus* differs in that the pronotum is wider than long, the prosternal lobe is not sculptured, the pleurosternal sutures are most widely separated in the middle of their length, the parameres are slender with pointed apices, the bursa is bulbous or roughly pyriform with two sclerites near the vaginal canal opening, and the spermatheca is shorter and less contorted. The other species of *Physorhinus* here treated agree well with these characters shown by *P. xanthocephalus*, but there are exceptions. Examination of 12 additional species assigned to *Anchastus* showed that one of these, *A. fumicollis* Fall agrees closely with *A. digitatus*. Ten others, including two exotic species, one from Africa, the other from Asia, differ from the type of both *Anchastus* and *Physorhinus* in genital characters, width and morphology of the pleurosternal sutures, lack of prosternal sculpturing, morphology and size of antennal segments 2 and 3, and total body size, some of the species being very much smaller than others. One species, *A. subdepressus* Fall belongs in the genus *Physorhinus*, since it displays characters which agree with those given above for *P. xanthocephalus*, differing only in that the pleurosternal sutures are narrower than usual. However, it does not exhibit the yellow frons and greatly extended metacoxal plates which were until now considered important characters in separating *Physorhinus* from *Anchastus*.

Seven *Physorhinus* species were recently named from the Galápagos Islands (Van Dyke, 1953). They further prove the unreliability of the characters used in the past to separate *Physorhinus* and *Anchastus*, in that they all lack the yellow frons. I was able to examine two of these species and found also that the metacoxal plates are not extended caudally as they are among the yellow-headed species from the mainland. These exceptions led to further analysis, and it was found that the *Physorhinus* and *Anchastus* species examined here differ in the mode of articulation of antennal segments 1 and 2. In *Physorhinus* segment 2 joins 1 on the inner side of 1, leaving the distal end of segment 1 to form a rounded cap over the end of segment 2. In *Anchastus*, segment 2 joins 1 on its distal end (figure 1). This difference in the manner of antennal segment articulation and the differences in the genitalia described before appear to be

more fundamental and universal than the characters heretofore used in separating the two genera. It is important to point out that this analysis of generic differences is far from exhaustive and will have to be used with care until further research tests its validity.

In addition, the examination of *Anchastus* showed that several species have antennal segment 3 similar in size and morphology to segment 4, while only segment 2 is small and cylindrical. In the *Physorhinus* species here examined and in the type species of *Anchastus*, both segments 2 and 3 are small and cylindrical or subcylindrical. This and other differences within the genus suggests that *Anchastus*, as it is now constituted, may contain more than one genus.

Nothing is known about the biology of the *Physorhinus* species, and there are no data on life histories or food preferences which might be used to delimit species. Although some label data give the names of plants on which specimens were taken, this information is not proof of host plant relationships since the insects may simply have alighted before being caught, and the data are so sketchy that no tentative correlations may be made. Adults appear to be active the year around in the tropics, but here again data are not sufficient to indicate peaks of activity.

No sexual dimorphism was observed. Champion (1895) believed that the antennae of the males were longer than those of the females in several species, but his conclusions are based on few specimens, and no such conclusions can be drawn from the present study.

Locality data are cited under the listings of specimens examined. Distribution is sometimes indicative of specific differences, as in the case of *P. cruciatus* and *P. insularis.*

Material for the revision was borrowed from a number of individuals, museums and universities both in the United States and Europe (abbreviations used later in the text are given after the name of the individual or institution, following the system proposed by Arnett and Samuelson, 1969): American Museum of Natural History, New York (AMNH); Academy of Natural Sciences of Philadelphia (ANSP); British Museum (Natural History), London (BMNH); California Academy of Sciences, San Francisco (CASC); Cornell University, Ithaca (CUIC); Deutsches Entomologisches Institut, Eberswalde (DEIC); Canadian National Collection of Insects, Ottawa (CNCI); Field Museum of Natural History, Chicago (FMNH); Mr. Gerard E. Flory, Lincoln Memorial University, Harrogate, Tennessee (GEFC); Institute Royal des Sciences Naturalles de Belgique, Brussells (IRSN); Institute for the Study of Natural Species, Lafayette, Indiana (ISNS); Dr. J. N. L. Stibick (JNLS); Museum of Comparative Zoology, Cambridge (MCZC); Museum fur Naturkunde, Berlin (MFNC); Museum G. Frey, Tutzing (MGFC); Museum National d'Histoire Naturelle, Paris (MNHN); Mr. M. W. Stone, Riverside, California (MWSC), Naturhistoriska Riksmuseet, Stockholm (NRIC); Ohio State University, Columbus (OSUC); University of Kansas, Snow Entomological Museum, Lawrence (SEMC); University of California, Berkeley (UCBC); University

of California, Davis (UCDC); United States National Museum, Washington, D. C. (USNM); and the Universitetets Zoologiske Museum, Copenhagen (UZMC).

DIAGNOSTIC CHARACTERS

Many characters were examined for usefulness in separating the various *Physorhinus* species. Those which were found of value are discussed below.

Head.—A triangular brownish macula is found at the base of the head in several species, and it occurs most consistantly in *P. erythrocephalus*; only a few specimens of this species were seen in which it is lacking. The characteristic brown border around the frons which often occurs in *P. frontalis* has not been discovered in any of the other species described here. The nasale is almost always more or less flat and rectangular or subrectangular. Only in *P. sexnotatus* it is consistantly concave, with the lateral anterior edges raised into distinct ridges.

Antennae.—The following antennal characters are common to all the species examined here: segments 2 and 3 smaller than all the others, segments 4-11 compressed and similar to each other in morphology, almost always each of segments 4-11 has a more or less distinct median longitudinal dark brown streak; this is rarely lacking, sometimes it is probably masked by the dark brown color of the antennal segments themselves. *P. sexnotatus, P. xanthocephalus,* and *P. marginatus* all have these dark streaks raised into more or less distinct carinae, usually on segments 4-8. In these species segment 1 also bears a median carina. Antennal length varies considerably intraspecifically, but the extraordinarily long antennae of *P. longicornis* are useful in distinguishing this species.

Pronotum.—The shape, color and punctation of the pronotum vary somewhat intraspecifically, yet the pronotum offers several useful characters for the separation of species. Color is useful in separating *P. marginatus* from all other species because of its flavous pronotal borders. Both *P. marginatus* and *P. insularis* have a distinctly broad, almost flat pronotum, while in *P. frontalis, P. fusculus,* and *P. lateralis* the pronotum tends to be more distinctly convex. In almost all cases pronotal punctation increases in size and density on the anterior sides of the pronotum, and the extent of coarse, deep pronotal punctation onto the hind angles is important in separating *P. fusculus* from similar species. The density of pronotal punctation on the disc and sides is quite noticably greater on such species as *P. fusculus, P. frontalis,* and *P. sturmii* than on *P. erythrocephalus, P. distigma* and others. The hind angles of the pronotum are as a rule bicarinate with the carinae well developed, except in *P. longicornis* and *P. sellatus* where the supramarginal carinae are very weakly developed or lacking altogether. In *P. fusculus, P. frontalis,* and *P. sturmii* the area between the carinae is flat or even slightly concave, making the hind angles appear not to blend smoothly into

the contour of the pronotal disc, as they do for example in *P. distigma*, where the space between the carinae is convex.

Elytra.—The most useful feature of the elytra is the presence or absence of maculae and the pattern of maculation, which is constant in all the species except *P. distigma* where there is considerable variation in size, shape, and intensity, but not in number of maculae. Also in *P. sexnotatus*, the second pair of elytral maculae is much smaller in several specimens from Costa Rica than in those specimens from further south. Elytral striation, though variable, can be helpful in identifying several species. For example, in *P. quadrinotatus* only the sutural stria is distinct, while in *P. boliviensis* 9 striae can be distinguished. In *P. stellatus* elytral striation is absent except for the sutural stria, while in *P. fusculus* and *P. frontalis* striation is well developed and distinct. Elytral apices are distinctly serrate in most of the species, but in *P. fusculus, P. frontalis, P. lateralis* and *P. sturmii* serration is absent or at most very fine.

Metacoxal plates.—The extent of development and the shape of the metacoxal plates is of limited use in separating some of the species. In *P. xanthocephalus* and *P. stellatus* the metacoxal plates are triangularly produced to acute apices which generally do not reach the second abdominal segment. *P. erythrocephalus* has the metacoxal plates more bluntly rounded and almost always reaching the second abdominal segment. *P. sexnotatus* has metacoxal plates which are narrowly and acutely produced, often reaching beyond the anterior edge of the second abdominal segment.

Male genitalia.—The genitalia of the species examined here are all very similar in appearance, with simple, acutely pointed parameres, each paramere bearing 3 setae near its apex, 2 ventrally and 1 dorsally placed. These setae are common to all the species and are not shown in the illustrations.

The genitalia differ chiefly in the length of the parameres and the amount of curvature of their outer margins, when viewed from the venter. There is a good deal of intraspecific variation, and the examples described and illustrated were chosen because they appear to best represent the species in question. In general, male genitalia should not be used to separate species, with the exception of those of *P. frontalis* which have a minute but distinct notch at the apex of each paramere where its inner margin is drawn out into a fine point. One or two additional differences can be mentioned. For example, *P. longicornis* has a long, slender genital apparatus in comparison with the other species. The parameres of *P. erythrocephalus* are quite strongly curved in comparison to those of *P. stellatus* or *P. xanthocephalus* and others. In *P. marginatus* the basal ends of the parameres join to form a more rounded arch than in any of the other species.

Female genitalia.—The female genitalia are much more distinctive than the male genitalia, and they can be used to separate groups of species or single

species. This will be apparent from an examination of the illustrations and descriptions. In all cases the spermatheca has a row of fine scales which sometimes has the appearance of a zipper along the side of the spermatheca, and sometimes forms a wide band along the spermathecal wall. The individual scales examined under high magnification may show specific differences; however, they were not examined in this manner since the more obvious features of the female genitalia provide suitable diagnostic characters. Size, shape and number of bursal sclerites, spermathecal shape and accessory gland position are important diagnostic features. The illustrations show only the bursa and bursal sclerites, spermatheca with scales and the bulbous or sausage-like accessory gland attached to the spermatheca.

KEY TO THE *Physorhinus* SPECIES OF NORTH, CENTRAL, AND SOUTH AMERICA

1. Flavous maculae present on elytra 2
   Maculae absent or so large as to cover most of elytra, or elytra with lateral flavous bands 8

2(1). Elytra yellow brown to piceous red brown with 2 subapical variable maculae. **distigma**
   Maculae more than 2 3

3(2). Maculae 4 4
   Maculae 6 7

4(3). Basal elytral maculae as large or larger than apical maculae 5
   Basal elytral maculae smaller than apical maculae 6

5(4). Elytra piceous to red brown with 4 subapical maculae, 2 toward bases, 2 toward apices; pronotum with lateral flavous bands . . . . . **marginatus**
   Elytra red brown to yellow brown; 2 slightly oblong maculae toward bases, 2 smaller and rounder toward apices; pronotum without lateral flavous bands . . . . . **erythrocephalus**

6(4). Elytra red brown to brown, 2 small round maculae at outer margins just below bases, 2 larger subapical round maculae; sutural striae alone distinct (Central America) . . . . . **quadrinotatus**
   Elytra red brown; each elytron with small round macula centrally placed below base, and larger, oblong macula toward apex; 9 elytral striae distinguishable (Bolivia) . . . . . **boliviensis**

7(3). Elytra yellow brown to brown, 2 small basal maculae distinct or obscure, 2 oval and laterally placed, large or small, 2 before apices; antennal segments 1 and 4-9 or 10 with median longitudinal carinae . . . . . **sexnotatus**
   Elytra shiny yellow brown to brown, 4 small maculae slightly beyond base, 2 much larger, laterally placed beyond middle; antennal segments without carinae . . . . . **stellatus**

8(1). Hind angles or prothorax unicarinate or with supramarginal carina very weakly developed; antennae long, half of body length or more, antennal segments 3-5 times as long as broad; prothorax dark, elytra light yellow brown and narrowly tapered. . . . . **longicornis**